

STEVENS (GEO. T.)

ON

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L I G H T

IN SOME OF ITS

RELATIONS TO DISEASE.

BY

GEORGE T. STEVENS, M. D.,
ALBANY, N. Y.

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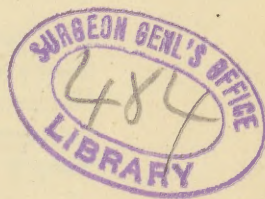
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ON LIGHT IN SOME OF ITS RELATIONS TO DISEASE.¹

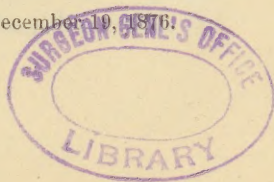
So important, so indispensable, in fact, is the agency of light to life that Lavoisier was warranted in the assertion that, "without light, Nature were without life and soul; and a beneficent God, in spreading light over creation, strewed the surface of the earth with organization, with sensation, and with thought."

To speak of such an agency in relation to disease as cause and effect may appear paradoxical, especially when we remember that, in the recent great advances in sanitary subjects, in few if in any other directions have the efforts of the sanitarian been so well rewarded as in letting light into dark places. Like the perturbed spirits which of old were supposed to be doomed to walk the night, but which vanished at the approach of dawn, disease and death have often fled before a beam of light which modern science has admitted into some dark corner.

It is said that soldiers quartered on the sunny side of a barrack possess great advantages in point of immunity from disease over their comrades who occupy the shady side; and experience in large hospitals seems to justify the conclusion that patients confined by lingering and debilitating diseases do best in the wards most exposed to the sunlight.

If light, then, is essential to life, is a destroyer of ferments and contagions, and is conducive to the recovery of the sick,

¹ An address read before the Albany Institute, December 19, 1876.



how can it be regarded as a cause of disease? We may in a general way reply that any agent which is powerful for good is also potent for evil—that there is no light without its compensating shadow. But to be more specific, and to come as directly as possible to the subject of discussion to-night, let me say at once that I propose only to consider briefly the important *rôle* which light plays in producing or in predisposing to certain classes of disease, as it passes through the transparent media of the human eye.

It will be necessary, before advancing to the main discussion of such a subject, to review briefly some elementary principles which are well established in regard to the classes of troubles which will engage our attention, as well as to glance hastily at some points in the physiology of vision.

We frequently meet with affections of the conducting nerves in which pains, convulsions, loss of sensibility, or other unnatural phenomena exist, but in which the pathologist, when he examines the affected nerves, or their surroundings, or even the more central parts from which these nerves are derived, finds either no appearance of morbid change, or, if any such changes are found, they are not constant and cannot be regarded as characteristic. Such affections are called functional nervous affections, or neuroses. Among them are neuralgia, the more common forms of headache, epilepsy, chorea, more commonly called, St. Vitus's dance, hysteria, and insanity. Pathologists have exercised great patience and industry in vain endeavors to find some constant organic condition which should lead to a better understanding of some one or all of these distressing and often alarming affections.

Failing in this, many able and earnest observers have devoted themselves to the careful study of the history and attending phenomena of these neuroses, with the result of collecting and arranging a great many most valuable facts. Among the most important and most interesting facts relating to the cause of these neuroses are those which show that there exists in a very large proportion of them a predisposition either hereditary or acquired by the individual subject to them.

This predisposition to functional nervous affections is well

established by the observations of careful and candid investigators, and is verified by the daily experience of many physicians. Persons possessing this unfortunate predisposition are liable from slight immediate causes to such troubles as neuralgia, headache, epilepsy, hysteria, insanity, and even consumption. In a large proportion of instances this predisposition is hereditary; and this inherited relationship to disease, while it has been carefully investigated by a few of our most able observers, has by the greatest number of practitioners of medicine been altogether too much overlooked. One who will investigate these hereditary tendencies will be surprised to find in how great a proportion of the victims of nervous trouble there is a family history of kindred affections. Thus a person who is an habitual sufferer from neuralgia may remember, when questioned, that one of his grandparents was also neuralgic, that his mother was a victim of oft-recurring nervous headaches, that his aunt has hysteria, and his cousin possibly epilepsy; and that, of his brothers and sisters, some have headaches or neuralgia, and others are such as are called nervous people.

Not long since I saw a boy of sixteen, who for ten years has been subject to epileptic fits. His mother, who was for many years subject to similar fits, died in early womanhood; her father, who is still living, has during the last few years been epileptic; and, by an interesting coincidence, on the day that I first saw the boy I also met a cousin of the mother, a resident of a distant town, who was himself a sufferer from this terrible malady, and whose mind had already become enfeebled by the disease.

Here is another instance, and one which, with slight variations, may be met with almost daily in the practice of many physicians. A gentleman from a neighboring city has always suffered from a general nervous irritability; he has been one of the class of excessively nervous people; his grandfather had always a great deal of neuralgia; but his father, who observed very strict habits of life, and whose occupation kept him much in the open air, had no nervous trouble. Three brothers have suffered terribly from neuralgia, and one, who for many years was subject to functional nerve-troubles, has

now an organic disease of the nervous centres. He has one sister, who is subject to oft-repeated nervous headaches.

Great attention has been paid to this predisposing tendency, both hereditary and spontaneous, by many of the most learned members of the medical profession; but, unless the hypothesis which I present to-night explains this peculiar and unfortunate tendency which forms the unwelcome inheritance of so many families, nothing has ever been known of it except its existence.

There is a peculiarity about this predisposing tendency which should be noted in passing—that persons affected with one form of functional nervous disturbance at one period of life, are liable to suffer from some other form at a later period. Thus, one who in childhood suffers from chorea (St. Vitus's dance), will generally, in later life, be the subject of severe recurring headaches, of neuralgia, or perhaps of epilepsy. It is a commonly-observed fact with physicians that hysterical girls usually become nervous women, subject to periodical headaches.

From such facts as these we may logically conclude that the predisposing cause of this class of troubles is a permanent one, that it often descends from parent to child, and that it is usually the same in different persons, and for different forms of functional nervous diseases.

About five years ago my attention was drawn to a singular and what seemed a constant relation between chorea, or St. Vitus's dance, one of the most characteristic and clearly-defined forms of nervous affections, and certain peculiarities in the manner in which light entered the eyes of the patients; and I was struck with the remarkable fact that intractable cases of chorea yielded when the conditions for correcting the eye-troubles were complied with. These circumstances would have led me to suppose that both the chorea and the visual defect were the result of a common cause, and that the remedy for one happened to be the remedy for the other; but, as the eye-troubles were not diseases, but simply natural peculiarities, which caused these patients to see at a disadvantage, that these conditions were congenital, and in many instances simply family features, as characteristic as the form of the nose

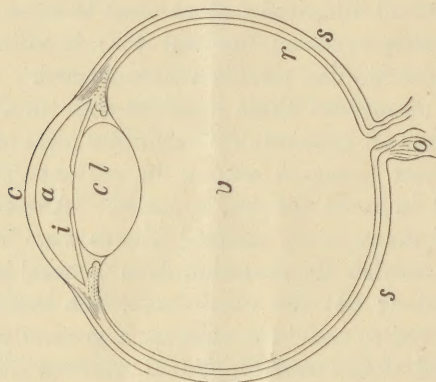
or the shape of the head, it became evident that, if any relationship existed between the eye-feature and the nervous disturbance, it must be the relation of cause and effect, and that the permanent and inherited feature must be the cause. Further investigation revealed the fact that in other forms of nervous troubles similar relations were formed. As those in whom I had discovered these relations were in almost every instance patients on account of a particular class of affections, I thought it best to search among the patients of those who were engaged in more general practice. Accordingly, the kind offices of many of my medical friends were brought into requisition to furnish the material, from general practice, for this investigation; but the results were the same as before. Hence I was led to conclude that, as a general rule, certain forms of visual defect and functional nervous diseases were in relation to each other as cause and effect.

Before proceeding further let us briefly review some points in the physiology of vision. When rays of light fall upon the surface of a healthy eye, they pass through the transparent portions, to reach the retina, which is the extremely delicate membrane constituting the inner lining of the posterior part of the eye, and is the sensitive surface on which the image is formed. But, in passing through these transparent portions, to reach the retina, the rays of light are bent, or, in technical terms, are refracted, so that they may be brought to a focus. In this diagram is represented the form of a section of an eye, showing the arrangement of the parts for refracting the rays of light.

The tough opaque shell of the eye, *s* (*sclera*), maintains its form, and holds in place the transparent humors which fill up its space. In front, this shell is changed to a transparent window, *c*, the cornea. Light from a luminous object passes through this transparent substance, and then through a body called the crystalline lens (*c. l.*), reaching at length the retina *r*. In order to form an image here these rays are refracted so as to bring them to a focus upon the retina; but, as objects are seen at different distances, some provision must be made for changing the focus of the eye. This you know is done in the opera-glass by turning the screw, so as to throw the lens

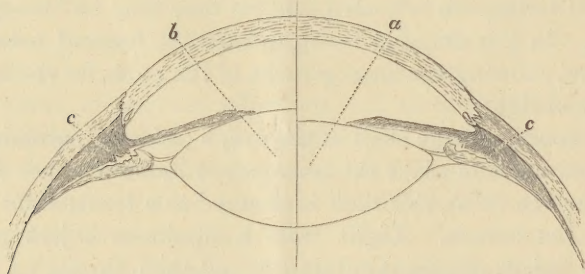
forward for near objects, and backward for distant ones. In the eye this change of focus is effected by the crystalline lens.

FIG. 1.



This lens is hung in its place by a delicate substance, which attaches it to an annular ring of muscular fibres, called the ciliary muscle (*c*, Fig. 2). When this ring of muscle contracts, the lens, by its elasticity, becomes thicker and more convex, and thus the rays passing through it are more strongly refracted, and near objects are distinctly seen.

FIG. 2.



(Fig. 2 shows the condition of the lens under these different circumstances. At *a* the ciliary muscle, *c*, is in repose, the lens is flattened, and the eye accommodated for distant objects. At *b* the ciliary muscle, *c*, is in a state of contraction, the lens is thickened, and is accommodated for the near point.)

This faculty of changing the focus is called the faculty of accommodation, and is in constant use as we turn our eyes

from near to distant objects. In an eye constructed on as strict optical principles as eyes should be, this change is very easily produced, and vision is perfect at all points with only the slight exertion of nerve and muscle force which can be maintained without fatigue or consciousness of exertion. In such an eye—which, because it is the best form of an eye, we will call a normal eye—the slight tension of the ciliary muscle which is necessary for near vision may be kept up for many hours with very little if any inconvenience. But we know that a constant tension upon a muscle or set of muscles, if it be even but a little more than Nature intended, soon produces fatigue. A pound-weight is but little for any one to hold; but let any person hold a pound weight in the palm of his hand while he bends the elbow so that the forearm is at right angles with the arm, and in a short time, varying from one to several minutes according to the muscular power of the arm, fatigue will be experienced;¹ and, if the experimenter is not accustomed to much exercise of the muscles of the arm, a rather painful sense of exhaustion may continue for a considerable time.

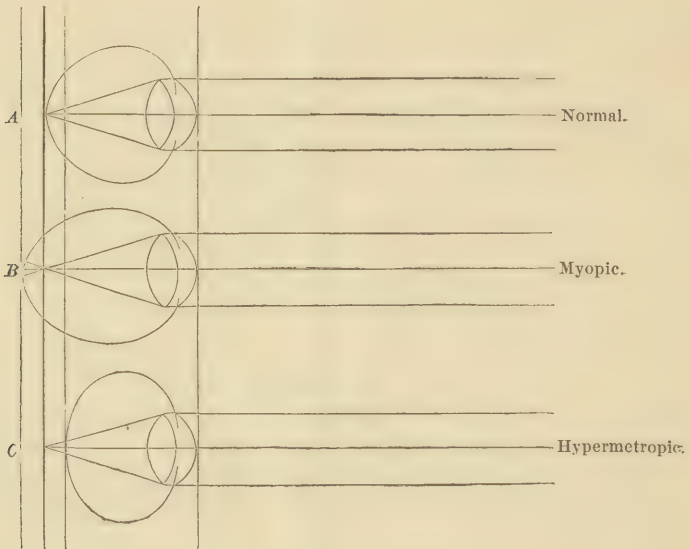
Now, it not unfrequently happens that such a constant and unnatural tension is forced upon this ciliary muscle which regulates the accommodation. For all eyes are not constructed upon the most perfect plan: some are too long, some too short, and some have not uniform refractive surfaces in different meridians.

The diagram here shown will assist in understanding this. In the figure at *A* we see rays from a distance, parallel rays, refracted in such a manner as to be brought to a focus at the retina. This is the normal eye. At *B* the rays at the same distance from the cornea have not reached the retina, but cross over and are separated before reaching it, so that a clear image of distant objects is not formed. This is the near-sighted eye, and is technically called a myopic eye. It is too long. At *C* we have the reverse of this condition. Here the eye is too short, and the diagram shows that the rays when they reach the retina are not yet brought to a focus, but could they pass through would unite in a focus behind the eye.

¹ Donders on Asthenopia.

This is the eye commonly called oversighted—technically, hypermetropic.

FIG. 3.



The oversighted person, in order to see even distant objects clearly, must begin to exert the faculty of accommodation. By contracting the ciliary muscle, such a person is enabled to see a distant object with either perfect or comparative distinctness. The force, if the eye is not much shortened, may not be more than the person with the normal eye exerts when he looks at a near point; but we see that, as the hypermetropic person brings the object near his eye, he must exert much more than the natural force in order to bring the rays to a proper focus. As this muscle is forced to contract by nervous influence, it will be seen that here is a source of nervous exhaustion, especially if the muscle is forced to a continued contraction, as is the case when such a person reads or works at needle-work for a considerable time.

Thus it will be seen that, while normal eyes are always at rest when accommodated for distance, and only slightly exerted when accommodated for the near point, hypermetropic eyes are never at rest except when closed; and that, in view-

ing near objects, an excessive effort is required, and that this excessive effort is increased in proportion as the hypermetropia is more considerable.

Nor is this the only disadvantage to which the hypermetropic eye is subjected :

As the object viewed approaches, the eyes converge. This may be easily seen by any one who will watch the eyes of another before whom he moves some small object backward and forward, while the person observed fixes his eyes upon it. This act of convergence is accomplished by a long muscle which lies at the nasal side of the eyeball, and which, by contracting, draws the eye toward the nose.

It will be seen that the effort of accommodation effected by the ciliary muscle within the eye, and the effort at convergence effected by the long straight muscle without the eye, are simultaneous ; but they are also exactly proportioned to each other, so that a pair of normal eyes accommodated for twelve inches is also converged for twelve inches. In a pair of hypermetropic eyes, however, this balance is lost, and a person having such eyes who accommodates for twelve inches requires an exertion on the part of the ciliary muscle equal to accommodating the normal eye for a nearer point—we will say, for six inches. In such a case, a corresponding convergence of the eyes will take place ; and so, while the eyes are accommodated for twelve inches, they are converged for six. Confusion of nervous and muscular action is the result ; there is disappointment of all the parts involved in the action, and in all affairs of muscles, of nerves, or of the heart, nothing is so depressing or distressing as disappointment.

To this confusion of nerve and muscle are due the pain, nausea, and vertigo, of the youth who attempts to read with his grandfather's spectacles, and this is the constant state of confusion of nerve and muscle in cases of erroneous refraction of the eyes. Let any one who imagines this nervous confusion to be of slight importance, if he have normal eyes, and has not reached the age when strong convex glasses are demanded, attempt to read for half an hour with magnifying spectacles of sixteen or eighteen inches' focal length, or let him study the landscape for a considerable time with a pair of glasses

adapted to a near-sighted person, and he will soon, by his aching eyes, his nausea and vertigo, acknowledge that here is a cause of nervous disturbance of no slight or insignificant pretensions; and when we remember that the immediate cause of convulsions and other alarming nervous disturbances is sometimes apparently trivial—such as a hastily-devoured meal or the taking of even a small amount of food which is illy digested—we cannot fail to perceive that this cause of irritation, prolonged through all the experience of the individual, must be abundantly potent to produce either of the functional disturbances of which we have spoken.

A form of error of refraction not yet referred to is a combination of other forms, and is called astigmatism, which means *without a point*. In this anomalous condition the refracting surfaces are different in different meridians of the eye, so that no exact focus can be formed, and there is an irrepressible conflict going on to correct the error, which can never be corrected without external help. This is a most vexatious cause of irritation and prolific source of nervous disturbances.

We are now, I think, prepared to bring our two classes of facts together and see if they will fit.

We have seen, in the early part of this discussion, that the tendency to nervous affections often runs in families, and that the nervous disturbances manifest themselves in different forms in different members of such families; that, in these families, what is sometimes called a “neuropathic predisposition” exists.

Now, it is also true that the faults of refraction are the unfortunate heritages of many families. Indeed, these refractive conditions are as much characteristic features, depending as they do on the form of the eye, as the form of the nose, the eyebrow, or the cheek-bones; and, as we see family likenesses prevailing among those who are related by ties of consanguinity, so these peculiarities in refraction are family inheritances.

Surely, it would be a most interesting and important fact were we to find that these nervous predispositions and these refractive evils were to be found in the same families, and yet this is precisely what I have proved in a large number of instances.

Let me give you one or two examples: A lady, who has for years been the subject of severe headaches, coming on almost every week, and continuing from one to three days, has one brother and two sisters living; a third sister died a few years since. The brother has from boyhood suffered from headaches; her elder sister was for years subject to convulsions, which deprived her of consciousness for a time, varying from a few minutes to half an hour, and which occurred about once in three or four weeks; these were possibly epileptic fits. The other living sister has always been subject to neuralgia and nervous headaches, and the sister who died was, like the last, a victim of neuralgia and headache. The eyes, both of the lady first mentioned and of the sister who had convulsions, were found, on testing, to be hypermetropic in a high degree, and from them it was learned that both of the other sisters and the brother were forced to put on old people's glasses before they were twenty-five years old, rendering it almost absolutely certain that they were all hypermetropic, and that this peculiar form of anomalous refraction was a family characteristic.

A medical friend complained of his oft-recurring nervous headaches, which he said he inherited from his father. He was induced to have the refraction of his eyes tested, when it was found that he had astigmatism. An elder sister who, during several years of her early life, was a victim of chorea, but of late a sufferer from intense neuralgia, and from that distressing form of headache called hemicrania, was found to have astigmatism in a high degree; and her only son, a boy sixteen years of age—who is, like his grandfather and uncle, a subject of headaches, recurring so frequently as to interfere with his education—is, like his mother and uncle, astigmatic. I might mention some scores of family histories, of which these are fair examples.

We are all aware of the fact of this inherited tendency to disease, and yet no person in his senses supposes that a disease like epilepsy or neuralgia is directly transmitted from one generation to another; and this subject of hereditary tendency has always been one of the great mysteries of medical science. But facial features are directly transmitted from parent to

child ; and, if the form of the eye can constitute an important cause of a class of diseases, the hereditary tendency to these diseases, if it exists, is readily explained.

It would be of little service to a person suffering from a nervous affection to assure him that he had an astigmatism or an hypermetropia, or that he was unequally myopic in the two eyes, unless science offered a relief to these unpleasant peculiarities. Fortunately, modern science is fully prepared to afford the relief demanded.

During the last few years, under the leadership of men of the highest genius, like Prof. Donders, of Utrecht, a class of medical men has brought the science of correcting anomalous refractions of the eye to a perfection which is truly wonderful. Formerly, when a person reached the age of forty-five or fifty, and found that he was, in the language of a medical friend, "forced to trombone his newspaper" in order to find the least uncomfortable distance at which to hold it, sought the nearest jeweler, bought a pair of spectacles which seemed nearest right, but which were often the most completely wrong, concluded that he was growing old, and losing his powers, and so, with as good grace as possible, submitted to the great cross and humiliation of his lifetime.

Now, however, we know that more than one-fifth of all the children in our schools have anomalous refractions, and that the wearing of glasses for the correction of these errors is neither an indication of age nor of foppery, but a sensible acceptance of the great benefits which science confers in such cases. No longer do those who are well informed in respect to such troubles seek a shop where glasses are kept on sale ; for one might about as well, if he desired his photograph taken, request his neighbor to sit for him, or search through the show-cases of the photographer for a good picture of himself ! He must sit for his own photograph, and he must sit for his own glasses, and often the highest scientific knowledge of the surgeon and the most consummate skill of the artisan are brought into requisition for the correction of a refractive error, of the very existence of which the patient is scarcely aware. Hitherto, this knowledge of the surgeon and skill of the worker in glass have been almost exclusively of service when the patient

complained of visual troubles. Henceforth, I am convinced that these visual troubles will be sought for in order to afford relief for and protection against many nervous affections.

It is said that "the proof of a pudding is in eating it," and the crucial test of a doctrine such as I have presented is its applicability in the management of the affections of which we have spoken. Does the correction of the eyes of patients relieve their nervous symptoms? I answer unhesitatingly, yes. This is no place to relate cures in medical practice, but, after a sufficiently extended and careful series of observations continued during more than four years, I can safely prophesy that this principle will be found of more universal application and more successful in its workings than any which has been advanced for the mitigation of this class of affections.

Many hundreds of persons suffer the strain upon the eye and upon the nervous system, as the result of these visual troubles, who are entirely unconscious of any defect of sight.

A robust-appearing German friend, who had adopted glasses for the correction of refractive errors on account of a nervous difficulty, when asked to describe the effect of his glasses upon him, replied: "When one who has a tight coat that he has worn so long he don't know it is tight, because he is used to it, gets another coat which is big enough, then he knows how he feels so much better. That is the way with my glasses. I did not know how bad I feel before, until I got my glasses and felt so much better."

How often do we see children of our schools, frequently the brightest and most ambitious of their class, struggling with irritable nerves, at a disadvantage in their studies, laying the seeds of future trouble, and often, as the time comes for selecting a pursuit in life, forced to abandon a chosen course of studies, because the confinement at such work is too great a strain upon them! I look forward to the time when these children who, from this single peculiarity, are placed at so serious a disadvantage in the struggle for life, shall find the relief that science is ready to afford them, and which would remove the weight that would otherwise prove a serious hindrance in their course.

We may compare the heart of a man to the main-spring

of a watch, while the delicate nerves which control the accommodation of the eye may be compared to the fine hair-spring of the time-keeper. It matters little how often we wind the watch, and thus supply tension to the main-spring, if the delicate hair-spring is not well fixed in its place—if it is a little too long or a little too short—our watch is out of time, and cannot be made to run true ; but, regulate the tension of this extremely delicate spring, and the movements of the watch become perfect and reliable.

So the heart may supply the force necessary for the perfect working of the human machine ; but if the tension upon these delicate nerves is not well regulated, there may be such nervous disturbances as seriously to impair the comfort and usefulness of the individual.

There may be a broken cog or an imperfect wheel in the time-keeper, which, in spite of main-spring or regulator, will sooner or later stop the watch ; and, in the human machine, there may be gross organic lesions which will disturb or destroy its workings ; but, excepting these, and other things being equal, the boy or the girl with the best heart and the best eye is most completely armed for the battle of life.

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